

### **Region 3 Plan Summary**

Richmond-Petersburg, Virginia 8-Hour Ozone Maintenance Plan and Richmond 1-Hour Ozone Maintenance Plan to Remove the Stage II Recovery Program

**Title:** The Removal of the Stage II Recovery Program from the Richmond-Petersburg, Virginia 8-Hour Ozone Area and the Richmond 1-Hour Ozone Maintenance Plans

**Federal Register Dates:** August 11, 2014, 79 FR 46711 (Proposed Rule); August 11, 2014, 79 FR 46767 (Final Rule).

**EPA Effective date:** October 10, 2014

**State Submittal Dates:** November 12, 2013

**Affected Areas:** Eastern Charles City County, Chesterfield County Colonial Heights City, Hanover County, Henrico County, Hopewell City, Petersburg City, Prince George County, Richmond City.

#### **Key Features:**

The revision to the Virginia State Implementation Plan (SIP) through the Virginia Department of Environmental Quality (VADEQ) to amend the existing, SIP-approved ozone maintenance plans for the Richmond 1990 1-hour ozone and Richmond-Petersburg 1997 8-hour Ozone National Ambient Air Quality Standard (NAAQS) Maintenance Areas (hereafter referred to as the Richmond Area). The revision also addresses the impact on the maintenance plans due to the eventual removal of Virginia's Stage II vapor recovery equipment from subject gasoline dispensing facilities in the Richmond Area. This SIP revision contains a demonstration that removal of the Stage II vapor recovery program will not interfere with attainment or maintenance of the NAAQS in accordance with section 110(l) of the Clean Air Act (CAA).

#### **Monitoring Network:** Stage II Vapor Recovery and Onboard Vapor Recovery Systems

Stage II vapor recovery (hereafter referred to as Stage II) is a means of capturing gasoline vapors displaced during transfer of gasoline from the gasoline dispensing unit to the motor vehicle fuel tank during vehicle refueling at a gasoline dispensing facility (GDF). Stage II vapor recovery involves use of special refueling nozzles and coaxial hoses for vapor collection at each gasoline pump at a subject GDF. Gasoline vapors belong to a class of pollutants known as volatile organic compounds (VOC). Gasoline is made up of a number of toxic compounds, and gasoline dispensing operations emit gasoline vapor that contains air toxics (also known as "hazardous air pollutants") that can cause cancer and other serious health effects. These include benzene, 1,3-butadiene, formaldehyde, acrolein, naphthalene, and polycyclic organic matter (POM), all of which are gas-phase hydrocarbons that exist in gasoline vapor (except POM, which exists in gas and particle phases).

Stage II gasoline vapor recovery systems have been a required emission control measure in areas classified as serious, severe, and extreme for the ozone NAAQS.<sup>1</sup> With the amendment of the CAA in 1990, Stage II controls were required for moderate ozone areas, under CAA section 182(b)(3).

However, under section 202(a)(6) of the CAA, 42 U.S.C. 7521(a)(6), the requirements of section 182(b)(3) no longer apply in moderate ozone nonattainment areas after EPA promulgated standards for onboard refueling vapor recovery (ORVR) as part of new motor vehicles' emission control systems.<sup>2</sup> Under implementation rules issued in 2002 for the 1997 8-hour ozone standard, EPA retained the Stage II-related requirements under section 182(b)(3) as they applied for the 1-hour ozone standard (see 40 CFR 51.900(f)(5) and 40 CFR 51.916(a)).

Beginning with model year 1998, ORVR equipment has been phased in for newly manufactured light duty passenger cars and trucks, and has been required on nearly all new vehicles since 2006.<sup>3</sup> ORVR is an emission control system contained in the vehicle that captures gasoline vapors during refueling. The gas tank and fill pipe are designed to capture refueling-related vapors and contain them in an onboard, activated carbon canister. When the vehicle is running and warmed up, the vapors are drawn out of the canister and transferred to the engine to be combusted as fuel. The ORVR system is very efficient and is monitored by the vehicle's on-board diagnostic system. Unlike Stage II systems, which are geographically limited to Stage II subject areas, ORVR is applicable to all new vehicles everywhere those vehicles operate.

Over time, non-ORVR vehicles continue to be replaced by ORVR-equipped vehicles. On May 16, 2012, EPA determined that ORVR technology is in widespread use throughout the U.S. vehicle fleet and waived the requirement for states to implement Stage II vapor recovery at GDFs in nonattainment areas classified as serious or above for the ozone NAAQS (77 FR 28772). EPA determined that emission reductions from ORVR-equipped vehicles are essentially equal to and will soon surpass the emission reductions achieved by Stage II alone (77 FR 28772). EPA determined that a state previously required to implement a Stage II vapor recovery program may take appropriate action to remove the measure from its SIP (77 FR 28772). EPA hereafter refers to this action as the "widespread use determination" or the "Stage II waiver."

### **Contingency Plan Triggers and Contingency Measures:**

Stage II vapor recovery was originally required by the CAA in 1990 in two Virginia ozone nonattainment areas -- the Northern Virginia and the Richmond 1-hour ozone nonattainment areas. Virginia adopted and published its Stage II vapor recovery regulations as Rule 4-37 of VR 120-01, entitled "Emission Standards for Petroleum Liquid Storage and Transfer Operations" in the November 2, 1992 edition of the *Virginia Register of Regulations (Vol 9, Issue 3)*, effective January 1, 1993. Virginia's Stage II rules applied to the Northern Virginia and Richmond VOC

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<sup>1</sup> See CAA section 182(b)(3), 42 U.S.C. 7511a(b)(3)

<sup>2</sup> See 59 FR 16262 (April 6, 1994), codified at 40 CFR Parts 86 (including 86.098-8), 88, and 600.

<sup>3</sup> Under the current regulatory construct, motorcycles and heavy-duty gasoline vehicles not manufactured as a complete chassis are not required to install ORVR, so they may be some small percentage of gasoline refueling emissions from new vehicles not captured by ORVR controls.

Emission Control Areas, as defined under 9 VAC 5-40-5200(B)(2) and 9 VAC 5-20-206. The Richmond VOC Control Area sets the boundaries for the Stage II program as: Charles City, Chesterfield, Hanover, and Henrico Counties and the Cities of Colonial Heights, Hopewell, and Richmond.

Virginia submitted its Stage II regulation to EPA as a SIP revision on November 5, 1992. EPA approved Virginia's Stage II SIP revision on June 23, 1994 (59 FR 32353).

#### Stage II and the Richmond 1-Hour Ozone NAAQS Redesignation Request and Maintenance Plan

Under the 1990 1-hour ozone NAAQS, EPA originally designated the Richmond-Petersburg area as a moderate ozone nonattainment area on November 6, 1991 (56 FR 56694). This included the Counties of Chesterfield, Henrico, and Hanover and the Cities of Colonial Heights, Hopewell, and Richmond, as well as the eastern portion of Charles City County. Upon improvement in air quality supported by three years of air monitoring data showing compliance with the 1-hour NAAQS, Virginia prepared a redesignation request and maintenance plan for the area, and submitted that plan to EPA for approval on July 26, 1996. EPA approved the Richmond 1-hour maintenance plan on November 17, 1997 (62 FR 61237). The SIP-approved maintenance plan relied upon, in part, reductions in emissions of VOCs from Stage II vapor recovery.

At the time EPA approved the Richmond 1-hour ozone redesignation request and maintenance plan SIP, Stage II was still a mandatory measure for areas classified as moderate ozone nonattainment under §182(b)(3) of the CAA. Although EPA had adopted ORVR rules for light-duty vehicles in April 1994, ORVR vehicles were not introduced for sale until beginning model year 1998, with nearly all new gasoline-powered vehicles being equipped with ORVR by model year 2006. Under Section 202 of the CAA, Stage II requirements for areas classified as moderate "shall not apply" upon EPA's promulgation of ORVR rules.<sup>4</sup> Although after ORVR promulgation Stage II was no longer a mandatory measure under the CAA for the Richmond moderate 1-hour ozone nonattainment area, Virginia had already crafted its 1-hour ozone redesignation request and maintenance plans. Virginia had relied upon reductions from Stage II in its ozone plans, and retained Stage II as a measure in its Richmond ozone plan. Although Virginia was no longer obligated to retain Stage II as a mandatory measure under the CAA, the Commonwealth would need to demonstrate that a SIP revision to remove Stage II would not interfere with the applicable requirements to attain the NAAQS.<sup>5</sup>

#### Stage II and the Richmond 8-Hour Ozone NAAQS Redesignation Request and Maintenance Plan

On April 30, 2004 (69 FR 23941), EPA designated the Richmond-Petersburg area as moderate nonattainment for the 1997 8-hr ozone NAAQS. EPA expanded the nonattainment area to include all of Charles City County, Prince George County, and the City of Petersburg. Again, after improvement in monitored air quality, the area qualified for attainment status and Virginia adopted a redesignation request and maintenance plan for the area. Virginia submitted this redesignation request/maintenance plan to EPA as a SIP revision on September 26, 2006. EPA approved the redesignation request on June 1, 2007 (72 FR 30485). Again, the maintenance plan for the area relied upon emission reductions resulting from the Stage II vapor recovery program.

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<sup>4</sup> See CAA section 202(a)(6), 42 U.S.C. 7521(a)(6)

<sup>5</sup> See CAA section 110(l), 42 U.S.C. 7410(l)

The maintenance plan included emission inventory for the 2005 attainment year and control strategy projection inventories for an interim year of 2011 for the end of the maintenance period in 2018. While the maintenance plan relied upon benefits from Stage II, the program was not expanded to include Virginia's expanded 1997 8-hour ozone NAAQS nonattainment area. On May 21, 2012 (77 FR 30160), EPA designated the Richmond-Petersburg area as attainment for the 2008 ozone NAAQS.

Even though the 1990 1-hour ozone NAAQS was revoked on June 15, 2005, EPA's subsequent implementation rules for the 1997 8-hour ozone NAAQS, retained the Stage II-related requirements under section 182(b)(3), but only as they applied to the area for the area's classification for the 1-hour NAAQS at designation for the 8-hour NAAQS (see 40 CFR 51.900(f)).<sup>6</sup>

## EPA Evaluation of Virginia's Richmond Maintenance Plan SIP Revision to Remove Stage II Vapor Recovery

### **A. Requirements**

The removal of Stage II gasoline vapor control programs from the SIP has to meet certain requirements. Any SIP revision that may relax the SIP, must meet the requirements of section 110(l) of the Clean Air Act. Section 110(l) requires a demonstration proving that the SIP would not be relaxed if the measure in question is removed. Additionally and specific to the removal of Stage II, certain areas must meet the requirements of CAA sections 184(b)(2) and 193. CAA section 184(b)(2) applies to areas that are in the Northeast Ozone Transport Region (OTR); these areas in the OTR are required to implement Stage II or another program with comparable emissions reductions, this requirement is referred to as the "comparable measures" requirement. Additionally, CAA Section 193, also referred to as the "general savings clause," requires areas trying to modify control measures approved prior to November 15, 1990 to prove that modification of the control measure "insures equivalent or greater emissions reductions." The Richmond Ozone Nonattainment Area did not have Stage II approved into its sip prior to November 15, 1990, therefore CAA Section 193 does not apply. The Richmond Nonattainment Area is not a part of the Northeast OTR therefore CAA Section 184(b)(2) does not apply. This SIP revision only needs to demonstrate compliance with CAA Section 110(l).

### **B. State Submittal**

Virginia DEQ submitted an analysis to satisfy the requirements of CAA section 110(l). VADEQ used the EPA guidance document *Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures* in developing its analysis to meet the requirements of CAA section 110(l).

The EPA guidance document, *Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures* provides direction to states on the calculations necessary for the analysis of the emissions impact of Stage

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<sup>6</sup> See 69 FR 23966 (April 30, 2004), as amended at 70 FR 30604 (May 26, 2005) and 70 FR 71702 (November 29, 2005)

II removal. To analyze the emissions impact of Stage II removal, the area wide impact on the VOC inventory must be calculated. As recommended by the guidance document, there are several methods that can be used to demonstrate compliance with the requirements of CAA section 110(l), any of the methods can be used and depend on how the removal of Stage II would affect the area in question. The first method is substituting Stage II with a new control measure that would offset any emissions increases that would result from the removal of Stage II. The second method involves substituting Stage II with excess emissions reductions not accounted for in the SIP. In the event that the removal of Stage II does cause an emissions increase, reductions in the VOC inventory since the previously approved SIP inventory can be used to offset any potential emissions increases resulting from the removal of Stage II. The third method does not involve substitution for any emissions increases in the event of an increase in VOC emissions from Stage II removal; this method allows the area to provide a phase-out plan that would allow a minuscule amount of emissions increases that decreases rapidly as ORVR continues to increase in the vehicle fleet. This minuscule amount of emissions increases would be too small to interfere with attainment or progress towards attainment. This noninterference can be demonstrated in several ways. The area can provide its most recent air quality data showing attainment of the NAAQS; if the NAAQS has yet to be attained, air quality projections showing attainment can be provided. Additional air quality analyses showing that the removal of Stage II does not interfere with attainment or maintenance of the NAAQS will also be considered.

To calculate the area wide VOC inventory impact, two important equations must be used. Equation 1, presented below, provides the overall Stage II-ORVR increment. This increment provides the percentage impact on the annual area-wide emissions control gain from Stage II as ORVR is phased into the vehicle fleet. Equation 2, also presented below, calculates the emissions benefits of Stage II on the VOC inventory in tons per year (tpy). Equations 3 and 4 provide the variables necessary to calculate the Stage II impact on the VOC inventory, these equations are also provided below.

**Equation 1:**  $increment_i = (QSII)(1-QORVR_i)(\eta_{iuSII}) - (QSII_{va})(CF_i)$

**Increment<sub>i</sub>:** The increment percentage impact on the annual area-wide emissions control gain from Stage II as ORVR is phased into the vehicle fleet

**QSII:** Fraction of gasoline throughput covered by Stage II

**QORVR<sub>i</sub>:** Fraction of annual gallons of highway motor gasoline dispensed to ORVR-equipped vehicles

**$\eta_{iuSII}$ :** In-use Stage II control efficiency

**QSII<sub>va</sub>:** Fraction of gasoline throughput covered by Stage II

**CF<sub>i</sub>:** Compatibility factor

**Equation 2:**  $Tons_i = (Increment_i)(GC_i)(EF)$

**Tons<sub>i</sub>:** VOC emissions benefit of Stage II (tons)

**Increment<sub>i</sub>:** The increment percentage impact on the refueling inventory from removing Stage II

**GCI:** The projected gasoline consumption (gal)

**EF:** The uncontrolled displacement refueling emissions factor (g/gal)

**Equation 3:**  $EF \text{ (g/gal)} = \exp[-1.2798 - 0.0049(\Delta T) + 0.0203(Td) + 0.1315(RVP)]$

**EF:** The uncontrolled displacement refueling emissions factor (g/gal)

**$\Delta T$ :** Values for this variable are area specific and are located in Appendix A-2 of the EPA guidance document (degrees fahrenheit)

**Td:** Values for this variable are area specific and are located in Appendix A-3 of the EPA guidance document (degrees fahrenheit)

**RVP:** Reid Vapor Pressure of the gasoline used for the area (pounds per square inch (psi))

Virginia DEQ submitted an analysis quantifying the VOC emissions benefits of Stage II. Equation 1 was utilized to yield the increments provided in Tables 1 and 2. The calculations in Table 1 assumed a Stage II control efficiency of 77% while the calculations in Table 2 assumed a Stage II control efficiency of 56%. Negative increment values are indicative of when excess emissions from non ORVR compatible Stage II systems overwhelm the emissions benefits of implementing Stage II. Table 1 presents calculated increment values which show that the Richmond-Petersburg Area will no longer see emissions benefits from Stage II after 2015. Table 2 presents calculated increment values which show that the Richmond-Petersburg Area will no longer see emissions benefits from Stage II after 2013. VADEQ used the more conservative Stage II efficiency estimate of 77% to determine the date when there will be no emissions benefits from Stage II; therefore, the Richmond-Petersburg area will no longer see emissions benefits from Stage II after 2015.

Table 1. Increment Calculations for 77% Stage II Efficiency	
Year	Increment
2002	0.49672
2005	0.34086
2008	0.20673
2009	0.16383
2010	0.12570
2011	0.09113
2012	0.06141
2013	0.03627
2014	0.01606
2015	0.00009
2016	-0.01256
2017	-0.0226
2018	-0.03065
2020	-0.04214

Table 2. Increment Calculations for 56% Stage II Efficiency	
Year	Increment
2002	0.35632
2005	0.23925
2008	0.13871
2009	0.10651
2010	0.07791
2011	0.05198
2012	0.02967
2013	0.01081
2014	-0.00435
2015	-0.01632
2016	-0.02581
2017	-0.03334
2018	-0.03937
2020	-0.04797

The emissions benefits of Stage II were calculated using Equations 2 and 3. Using the more conservative increments produced by using the 77% Stage II efficiency estimate, the emissions benefits were calculated and the values tabulated in Table 3, below. The calculations also prove that there will be no emissions benefits from Stage II implementation past 2015.

Table 3. Stage II Emissions Reductions in the Area-Wide VOC Inventory	
Year	Emissions Reductions (tpd VOC)
2002	2.17
2005	1.51
2008	0.87
2009	0.71
2010	0.55
2011	0.4
2012	0.28
2013	0.16
2014	0.07
2015	0.00
2016	-0.06
2017	-0.10
2018	-0.14
2020	-0.19

In addition to increment and area wide VOC inventory calculations, VADEQ submitted other evidence to support its removal of Stage II from the Virginia SIP. VADEQ included an analysis which calculated the non-ORVR compatible Stage II benefit on gasoline basis and a VMT basis and compared the analysis to the Stage II benefit calculated with the use of the Motor Vehicle Emission Simulator (MOVES2010a). This comparison is provided below in Table 4, and shows that incompatibility excess emissions exceed Stage II benefits between 2017 and 2018. Additionally, the VOC inventory from the Richmond-Petersburg Area's maintenance plan shows a large reduction in VOC emissions. As presented in Table 5, there is a 3.8 tpd decrease in VOC emissions from the attainment year of the 1997 8-hour Ozone NAAQS and the out-year in the maintenance plan. Also, the area's most recent regional emissions analysis completed for transportation conformity purposes presents a decreasing emissions trend for NO<sub>x</sub> and VOCs from motor vehicles. Results from the most recent emissions analysis are provided in Table 6. The emissions analysis conducted for 2018 yielded a 0.715 tpd decrease of VOC from the established VOC motor vehicle emissions budget (MVEB). This 0.715 tpd decrease of VOC outweighs the emissions benefit of Stage II in 2018; this is without taking into account the increases in emissions from Stage II systems that are incompatible with ORVR. Additionally, the shutdown of the Reynolds Metals-Bainbridge Facility, which shutdown in 2007, resulted in a reduction of 3.46 tpd of VOC. This reduction in VOC emissions alone would be more than sufficient to cover any emissions benefit achieved by Stage II.

Table 4. Excess and Benefit VOC Emissions Calculations Results					
Year	Excess Vent Emissions (tpd VOC)		Stage II Benefit (tpd VOC)	Stage II Benefit with respect to ORVR (tpd VOC)	
	Gasoline Basis	VMT Basis		Gasoline Basis	VMT Basis
2008	0.2147	0.2438	1.547	1.305	1.303
2009	0.2684	0.27	1.344	1.075	1.074
2010	0.2915	0.2924	1.148	0.857	0.856
2011	0.31	0.3118	1.148	0.836	0.836
2012	0.3358	0.3355	0.969	0.633	0.633
2013	0.3511	0.3504	0.816	0.465	0.466
2014	0.3623	0.3611	0.682	0.319	0.321
2015	0.3713	0.3697	0.567	0.196	0.198
2016	0.3789	0.3769	0.472	0.093	0.095
2017	0.3819	0.3796	0.399	0.017	0.020
2018	0.3833	0.3807	0.341	-0.042	-0.039
2020	0.3852	0.382	0.26	-0.125	-0.122
2030	0.3854	0.3793	0.153	-0.233	-0.227



Table 5. VOC Inventory					
Year	Point (tpd)	Area (tpd)	Nonroad (tpd)	Mobile (tpd)	Total (tpd)
2005	32.705	54.760	20.438	43.518	151.421
2011	36.074	60.315	15.898	32.343	144.630
2005-2011	3.369	5.555	-4.540	-11.175	-6.791
2018	39.900	68.331	15.515	23.845	147.591
2005-2018	7.195	13.571	-4.923	-19.673	-3.830

Table 6. Regional Emissions Analysis Results				
Year of Regional Emissions Analysis	VOCs (tpd)	NO <sub>x</sub> (tpd)	VOC MVEB (tpd)	NO <sub>x</sub> MVEB (tpd)
2018	23.13	25.03	23.845	26.827
2028	19.59	19.07		
2035	21.12	19.72		

Additionally, VADEQ submitted work completed by the Georgia Institute of Technology (Georgia Tech) for the Association for Southeastern Integrated Planning project. Georgia Tech completed emissions sensitivity analyses utilizing the Community Multiscale Air Quality (CMAQ) model, for the sensitivity of ozone concentrations with respect to NO<sub>x</sub> and VOC emissions. Three sensitivity analyses were conducted to gauge the sensitivity of ozone formation with respect to a 30% decrease in anthropogenic VOC, ground level NO<sub>x</sub> and point source NO<sub>x</sub> in the applicable Virginia areas. It was found that Ozone concentrations were most sensitive to decreases in point source NO<sub>x</sub>. The sensitivity to point source NO<sub>x</sub> is 100 times greater than ozone concentration sensitivity to anthropogenic VOC. The results indicate that NO<sub>x</sub> has a much larger impact on Ozone concentrations than VOC.

Through the CMAQ modeling utilized for the sensitivity analyses, the effect of Stage II on ozone concentrations was calculated at the monitors in Northern Virginia or Richmond. Table 8, below, presents the Stage II benefit in terms of the change of ozone concentration. The results presented show that Stage II has a very minuscule effect on ozone concentrations in the Northern Virginia and Richmond areas.

Table 7. Stage II Effect on Ozone Concentration		
Area	Monitor	Stage II Benefit to Ozone Concentrations (parts per billion (ppb))
Northern Virginia	Arlington	-1.72x10 <sup>-4</sup> to -2.87x10 <sup>-4</sup>
Richmond	Hanover	4.13x10 <sup>-6</sup> to 1.24x10 <sup>-5</sup>

**Conclusion:**

EPA thoroughly evaluated the submittal made by Virginia through VADEQ. EPA's detailed review has led EPA to conclude that VADEQ properly addressed the recommended increment and VOC inventory calculations which prove when Stage II no longer provides a benefit for the Richmond Area. EPA agreed with the date that VADEQ decided upon for withdrawal of the Stage II requirement. EPA also reviewed additional data provided by VADEQ showing decreasing VOC emissions trends in the Richmond Area and that ozone formation in the Richmond Area is much more NO<sub>x</sub> dependent. In conclusion, EPA agreed with Virginia's recommendation that the Stage II requirement be removed on January 1, 2017, since at that point in time, the Richmond Area will no longer see any emissions benefits from the implementation of Stage II. EPA has approved the removal of Stage II from the maintenance plans for the Richmond Area because the submitted analysis demonstrates that Stage II removal will not interfere with the attainment or maintenance of the NAAQS in accordance with section 110(l) of the CAA.